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Vipac Engineers & Scientists

Adelaide Brighton Cement Ltd

ABC Birkenhead Site

Noise Modelling Prediction

50B-16-0007-TRP-473094-2

24 May 2016

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EXECUTIVE SUMMARY

Vipac Engineers & Scientist Ltd (Vipac) was commissioned by Adelaide Brighton Cement (ABC) to conduct a Noise Impact Model Assessment for the ABC Birkenhead Plant operations on the existing residential located within the Port Adelaide, South Australia following the noise reduction abatement program on 4B Stack, Limestone Reclaimer, Cement Mill 1 Dust Collector fan and Cement Mill 1 compressor.

A noise emissions survey of the noise reduction abatement program equipment (4B Stack, Limestone Reclaimer Chain, Cement Mill 1 Dust Collector and Cement Mill 1 compressor) has been conducted during typical operations on the 15th April 2016 at the ABC Birkenhead site to determine the noise emission levels of this equipment following the recent modification works. Subsequently, the sound pressure measurements taken at the site were analysed and incorporated in the noise model.

The predicted noise levels due to the ABC Birkenhead Plant operations achieve the night time noise criteria for most of the noise sensitive receivers under neutral meteorological conditions with the exception of receivers R2, R5, R15 and R16, which are predicted to exceed by 3/4dB. The predicted noise levels at the receivers associated with the worst case weather condition are generally achieved the noise criteria at most of the receivers apart from six receivers (R2, R5, R10, R12, R15 and R16), which the predicted noise levels are raised above the noise criteria by 3dB or less.

A noise comparison between the pre and post noise abatement program was made to compare the noise reduction achieved due to the recent modification work on the 4B stack, limestone reclaimer chain, cement mill 1 dust collector fan and cement mill 1 compressor. Predicted noise levels for worst case meteorological condition were considered only as it representative of the worst case noise propagation. The results show that the noise reduction abatement program achieved the noise reduction at most of the sensitive receivers. No noise reduction was noted at these six receivers for the reason that the receivers are located further away from the recent modification noise sources and predicted noise levels at these receivers are most likely dominated by other noise sources in ABC plants.

The remaining noise sensitive receivers are predicted to achieve a noise reduction by up to 4dBA. For instance, noise receiver at R16 achieves the most noise reduction from the noise abatement program (reduction of 4dB) and follows by noise receivers at R6, R12 and R18, which gain a reduction of 3dB and noise receivers at R2, R5 and R17 gain a reduction of 2dB. Other noise receivers (R4, R13 and R15) are also benefited from the noise abatement program, which gain a reduction of 1dB.

Overall, the noise reduction abatement program achieved a noise reduction at most of the receivers. However, the noise levels are predicted to raise above the noise criteria by 3dB or less during the worst case meteorological condition at R2, R5, R10, R15 and R16. It should be noted that a 3dB change in noise level is just noticeable or perceptible to average human ear.

Vipac recommends to continue in conducting environmental noise surveys at the noise sensitive receivers in order to get an average/constant noise contribution from ABC Birkenhead Plant.

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1 INTRODUCTION

Vipac Engineers & Scientist Ltd (Vipac) was commissioned by Adelaide Brighton Cement (ABC) to conduct a noise impact model assessment for the ABC Birkenhead Plant operations on the existing residential located within the Port Adelaide, South Australia following the noise reduction abatement program on 4B Stack, Limestone Reclaimer, Cement Mill 1 Dust Collector fan and Cement Mill 1 compressor.

A noise emissions survey of the noise reduction abatement program equipment (4B Stack, Limestone Reclaimer Chain, Cement Mill 1 Dust Collector and Cement Mill 1 compressor) has been conducted during typical operations on the 15th April 2016 at the ABC Birkenhead site to determine the noise emission levels of this equipment following the recent modification works. Subsequently, the sound pressure measurements taken at the site were analysed and incorporated in the noise model.

2 REFERENCES

[1] Environment Protection (Noise) Policy 2007, South Australian government.

[2] Guidelines for the use of the Environment Protection (Noise) Policy 2007, June 2009, Environment Protection Authority (EPA).

[3] Vipac Report: 50B-16-0007-TRP-799543-0 – ABC Noise Survey February 2016.

[4] Vipac Report 50H-07-0035-TRP-423158-0- Stage 2 Sound Plan Model.

[5] Vipac Report 50B-15-0069-TRP-472973-2 Noise Impact Model Assessment – Existing Residential.

[6] Map source - Atlas of South Australia, retrieved 21st June 2010 from http://www.atlas.sa.gov.au, © Copyright Government of South Australia.

[7] Port Adelaide Enfield (City) Development Plan, Consolidated 21 April 2016, Development Act 1993.

[8] Bureau of Meteorology website 'Outer Harbor (Black Pole) Station', www.bom.gov.au.

[9] Vipac Report: 50B-16-0007-TRP-799629-0 – ABC Noise Survey May 2016.

3 PROJECT DESCRIPTION

Based on the available site maps, and our previous site inspections and environmental noise assessments, we note the boundaries of the subject site are as follows:

- North – General industry area to the north (across Wills Street).
- East – General industry area on the eastern side of Port River.
- South – Port River Expressway / Port River (Future Receivers under Renewal SA Plans).
- West – Predominantly residential area with a small strip of commercially zoned land along Victoria Road immediately opposite the Birkenhead Plant.

3.1 EXISTING RECEIVERS

Figure 3-1 below shows the receivers locations for the residential zone to the West of the Birkenhead plant and these locations are listed in Table 3-1, labelled R2-R18 (excluding R7).

Table 3-1 Unattended and Attended Measurement Locations

Measurement Location	Location Address/ Description
NL1	137 Victoria Rd, Birkenhead (Social Club)
R2	Corner of Alfred St and Hargrave St, Peterhead
R3	Adjacent to 145 Hargrave St, Peterhead (facing Fletcher Rd)

Measurement Location	Location Address/ Description
R4	Corner of Robert St and Hargrave St, Birkenhead
R5	Adjacent to 23 Levi St, Birkenhead
R6	Adjacent to 19 Craigie St, Birkenhead
R8	Adjacent to 39 Mary St, Peterhead
R9	Corner of Wills St and Whyte St, Peterhead
R10	Corner of Olive St and Victoria Rd, Largs Bay
R11	Adjacent to 158 Fletcher Rd, Largs Bay (facing east along Olive St)
R12	Adjacent to 33 Hilton St, Birkenhead
R13	Adjacent to 28 Whyte St, Peterhead (facing east down Matilda St)
R14	Adjacent to 15 Waverley St, Largs Bay
R15	Adjacent to 9 Walton St, Peterhead
R16	Adjacent to 77 Victoria Rd, Birkenhead
R17	Corner of Fletcher Rd and Rose St, Birkenhead (adjacent to 53 Fletcher Rd)
R18	Adjacent to 20 Fletcher Rd, Birkenhead (In the park)

Figure 3-1: Attended Noise Measurement Locations near Birkenhead plant [3]

3.2 NOISE REDUCTION ABATEMENT PROGRAM

The noise reduction abatement program has been undertaken on the following equipment and changes to the equipment are as follow:

- Refurbishment of 4B stack silencer,
- Limestone reclaimer chain assembly replacement,
- Installation of silencer on Cement Mill 1 compressor,
- Change in fan speed of Cement Mill 1 dust collector.

4 ENVIRONMENTAL NOISE CRITERIA

4.1 SOUTH AUSTRALIA – ENVIRONMENTAL PROTECTION (NOISE) POLICY 2007

The environmental noise criteria used in our assessment are based on the requirements of the Environment Protection (Noise) Policy 2007 [1].

The Environment Protection (Noise) Policy 2007 sets out the maximum allowable noise levels based on the time of day and intended land use, applicable at the most noise sensitive premises. Based on the Development Plan, we note that the area encompassing the Birkenhead Plant and the proposed SA Redevelopment receivers located south of the Birkenhead Plant comprises of Light Industry (LIn), Commercial (C) and Residential (R) land uses.

We note the following indicative noise factors stipulated by the Environment Protection (Noise) Policy 2007 for the relevant development plan zoning outlined above:

- Light Industry Zone – A zone accommodating a range of light industrial, storage and warehouse land uses.
  - Day-time indicative noise factor: 57dB(A);
  - Night-time indicative noise factor: 50dB(A).
- Commercial Zone – A zone accommodating a range of commercial uses.
  - Day-time indicative noise factor: 62dB(A);
  - Night-time indicative noise factor: 55dB(A).
- Residential Zone – A zone promoting a diverse range of housing styles that meet the needs of all people.
  - Day-time indicative noise factor: 52dB(A);
  - Night-time indicative noise factor: 45dB(A).

Based on the average of the source and receiver indicative noise factors in accordance with the Environment Protection Policy, and Table 1 of the EPP where the noise source and receiver fall within the same land use category, we note the following indicative noise levels for the respective receivers as provided in Table 4-1 (rounded to the nearest whole number).

Table 4-1: Day-time and night-time indicative noise levels for noise sensitive receivers in the vicinity of the ABC Birkenhead Plant (dB(A) re 20µPa)

Source	Receiver	Indicative Noise Level	
		Day-time, dB(A) 7am to 10pm	Night-time, dB(A) 10pm to 7am
General Industry Zone	Light Industry Zone	61dB(A)	53dB(A)
	Commercial Zone	64dB(A)	55dB(A)
	Residential Zone	59dB(A)	50dB(A)

Note that for noise containing a characteristic (tonal, impulsive, low frequency or modulating), the following adjustments are to be made to the source noise level:

- Noise containing 1 characteristic – a 5dB(A) penalty must be applied to the noise level (continuous);
- Noise containing 2 characteristics – an 8dB(A) penalty must be applied to the noise level (continuous);
- Noise containing 3 or 4 characteristics – a 10dB(A) penalty must be applied to the noise level (continuous).

5 ATTENDED NOISE MEASUREMENTS

A noise survey was undertaken at 16 residential receiver locations [9], in order to capture the existing noise levels (and identify the dominant noise sources) in the vicinity. Table 5-1 provide a summary of the night time attended measurements respectively.

Table 5-1: Summary of Night-time Attended Measurements at Residential Receivers

Measurement Location	Date/Time	Criteria dB(A)	Noise Level (L_{A90}) dB(A)	Noise Level (L_{Aeq}) dB(A)	Exceedance (dBA)	Wind Speed (m/s)	Wind Direction (deg)
R2	10/05/16 22:05	50	53	54	4	9.7	247.5
R3	12/04/16 23:07	50	46	47	—	3.1	135
R4	12/04/16 23:28	50	38	40	—	1.9	135
R5	12/04/16 22:39	50	49	50	—	4.7	135
R6	12/04/16 22:26	50	41	42	—	4.7	135
R8	12/04/16 23:27	50	47	47	—	1.9	135
R9	12/04/16 23:59	50	38	40	—	1.7	112.5
R10	12/04/16 23:43	50	48	60	—	1.9	135
R11	13/04/16 00:00	50	42	47	—	1.7	112.5
R12	10/05/16 22:52	50	48	49	—	8.3	247.5
R13	12/04/16 23:44	50	41	42	—	1.9	135
R14	13/04/16 00:19	50	39	41	—	1.9	90
R15	12/04/16 23:12	50	50	54	4	3.1	135
R16	10/05/16 23:49	50	50	54	4	7.8	247.5
R17	12/04/16 22:42	50	40	44	—	4.7	135
R18	12/04/16 22:04	50	40	44	—	6.7	157.5

Night time measurements revealed exceedance of the relevant environmental noise criteria at locations R2, R15 and R16. Positions R10 was dominated by traffic noise along Victoria Road. For this position the L_{A90} was more than 10 dB less than the L_{Aeq} value indicating the measurement was most likely influenced by traffic noise. Although the measured noise levels at R2, R15 and R16 may have been affected by traffic noise it is unlikely due to the small variation between the L_{A90} and L_{Aeq}. For R2 and R15, local traffic noise was absent from the measurements however distant traffic noise may have contributed to the overall noise levels. For R16 measurements were conducted without traffic noise within the vicinity of the measurement location, however due to volume of traffic along Victoria Road, distant components of this traffic noise may have affected the overall noise levels.

6 NOISE MODELLING

Noise prediction was carried out using the validated SoundPLAN acoustic modelling software. The CONCAWE noise propagation algorithm was used in accordance with the guidelines for assessment against the Environment Protection (Noise) Policy 2007 [1].

For the prediction of noise impacting on nearby noise sensitive receivers, the acoustic model of the plant was run assuming neutral (i.e. no wind, calm) and worst- case meteorological conditions (i.e. 5m/s steady wind from noise sources to receiver locations). It should be noted that this assumption of worst-case noise source to receiver wind direction is conservative (i.e. only one wind direction would be experienced at any time).

6.1 NOISE SOURCES

The noise emission data for ABC infrastructure (mechanical plant & equipment) were extracted from Vipac report entitled "*Noise Impact Model Assessment – Existing Residential*" (ref no: 50B-15-0069-TRP-472973-2) with the exception of noise emission data for 4B stack, limestone Reclaimer chain, cement mill 1 dust collector fans and cement mill 1 compressor. Noise emission data for these mechanical plants were updated following the noise reduction abatement program.

Appendix B details the updated sound pressure levels for 4B stack, limestone Reclaimer chain, cement mill 1 dust collector and cement mill 1 compressor following the recent modification of the mechanical plants.

6.2 NOISE MODEL CALIBRATION

Noise modelling calibration was carried out at 16 residential locations highlighted within Figure 3-1. The predicted noise levels at these residential locations were then compared with the measured noise levels that were conducted during night period on April 2016 and May 2016 [9], as detailed in Section 5 of this report. The noise prediction was also based on the meteorological conditions at the time of the attended.

6.3 MODELLING ASSUMPTIONS

The following assumptions were made in developing the acoustic model of the ABC Birkenhead Plant:

- The areas surrounding the ABC Birkenhead plant, the noise sources and the receiver locations were assumed to be flat terrain.
- The ground absorption in the ABC Birkenhead plant and in the vicinity of the plant was assumed to be fully reflective (based on observations on-site and the previously validated predictive model of the Birkenhead facility, discussed in Vipac Report 50H-07-0035-TRP-423158-0 [4].

- Building heights for existing buildings within the ABC Birkenhead plant were extracted from previous noise model, as discussed in Vipac Report 50H-11-0044-TRP-775497-4.
- Acoustic modelling has been conducted based on all sliding / roller doors / windows being fully closed during typical operations.
- The influence of traffic noise or noise from other nearby sources is not included in the noise model.
- Weather conditions were sourced from Bureau of Meteorology 'Outer Harbor' Station.
- The wall cladding for lime stone reclaimer, cement mill 1 and 7 were constructed with 0.62mm corrugated metal steel.

7 ASSESSMENT AND RESULTS

7.1 NOISE MODEL VALIDATION

The predicted noise levels generated by the SoundPLAN model were compared to the measured noise levels during April 2016 and May 2016 for validation purposes and are summarised in Table 7-1 below:

Table 7-1: Model Validation - Comparison of measured to predicted noise levels

Location	Measured noise levels dB(A) L_{A90}/L_{Aeq}	Predicted Noise Levels L_{eq} dB(A)	Difference [1]
R2	53/54	52	-1
R3	47	48	1
R4	40	43	3
R5	50	53	3
R6	42	45	3
R8	47	47	0
R9	40	40	0
R10	48	51	3
R11	42	41	-1
R12	49	49	0
R13	42	43	1
R14	41	41	0
R15	50/54	52	-2
R16	50/54	51	-3
R17	40/44	44	0
R18	40/44	40	-4

Note: 1. Note that a negative number denotes an under prediction and positive denotes an over prediction

In general, the predicted noise levels are within the range that would be considered 'in good agreement' with the measured data, especially given the complexity of the plant model and the very high number of noise sources.

7.2 EXISTING NOISE SENSITIVE RECEIVERS

Noise prediction modelling has been carried out to identify the potential impact associated with the existing ABC Birkenhead plant operations on the existing noise environment at the nearest existing residential receivers identified in Figure 3-1. The predicted noise levels representative of the operational phase of the ABC Birkenhead plant post to noise reduction abatement program for both neutral weather condition and worst-case weather condition are presented in Table 7-2.

Note that for each receiver / scenario, the predicted noise levels in Table 7-2 has been assessed against the relevant night-time equivalent noise criterion for the respective locality as follows:

- No colour - Predicted noise levels achieve the night time noise criterion.
- Orange - Predicted noise levels marginally exceed the night time noise criterion (by less than 3dB(A) which would generally be inaudible to the average human ear[1])).
- Red – Predicted noise levels exceed the night time noise criterion (by greater than 3dB(A))

Appendix C provides the noise contour maps associated with the acoustic modelled scenarios in respect of the ABC Birkenhead operations.

Table 7-2: Predicted Noise Impact at Existing Receivers at 1.5m above ground level

Receiver ID	Neutral	Worst Case	Noise Criteria
R2	52	53	50
R3	46	48	50
R4	41	44	50
R5	52	53	50
R6	43	45	50
R8	46	47	50
R9	39	41	50
R10	48	52	50
R11	40	42	50
R12	50	52	50
R13	41	43	50
R14	39	42	50
R15	51	52	50
R16	52	53	50
R17	42	44	50
R18	42	44	50

[1] *The subjective response or reaction to changes in noise levels can be described as follows: A 3dB(A) change in sound pressure level is just noticeable or perceptible to the average human ear; a 5dB(A) increase is quite noticeable and a 10dB(A) increase is typically perceived as a doubling in loudness.*

The predicted noise levels due to the ABC Birkenhead Plant operations achieve the night time noise criteria for most of the noise sensitive receivers under neutral meteorological conditions with the exception of receivers R2, R5, R15 and R16, which are predicted to exceed by ~3dB. The predicted noise levels at the receivers associated with the worst case weather condition are generally achieved the noise criteria at most of the receivers apart from six receivers (R2, R5, R10, R12, R15 and R16), which the predicted noise levels are raised above the noise criteria by ~3dB.

A noise comparison between the pre and post noise abatement program was made to compare the noise reduction achieved due to the recent modification work on the 4B stack, limestone reclaimer chain, cement mill 1 dust collector fan and cement mill 1 compressor. Predicted noise levels for worst case meteorological condition were considered only as it representative of the worst case noise propagation. Table 7-3 shows a comparison between the pre and post abatement program at the noise sensitive receivers during worst case meteorological condition.

Table 7-3: Predicted Noise Levels comparison between pre and post noise abatement program during worst case meteorological condition

Receiver ID	Pre-Noise Abatement Program	Post-Noise Abatement Program	Difference
R2	55	53	-2
R3	48	48	0
R4	45	44	-1
R5	55	53	-2
R6	48	45	-3
R8	47	47	0
R9	41	41	0
R10	52	52	0
R11	42	42	0
R12	55	52	-3
R13	44	43	-1
R14	42	42	0
R15	53	52	-1
R16	57	53	-4
R17	46	44	-2
R18	47	44	-3

As shown in Table 7-3, the noise reduction abatement program achieved the noise reduction at most of the sensitive receivers with the exception of six receivers (R3, R8, R9, R10, R11 and R14). No noise reduction was noted at these six receivers for the reason that the receivers are located further away from the recent modification noise sources and predicted noise levels at these receivers are most likely dominated by other noise sources in ABC plants.

The remaining noise sensitive receivers are predicted to achieve a noise reduction by up to 4dBA. For instance, noise receiver at R16 achieves the most noise reduction from the noise abatement program (reduction of 4dB) and follows by noise receivers at R6, R12 and R18, which gain a reduction of 3dB and noise receivers at R2, R5 and R17 gain a reduction of 2dB. Other noise receivers (R4, R13 and R15) are also benefited from the noise abatement program, which gain a reduction of 1dB.

8 CONCLUSION

A noise impact model assessment for the ABC Birkenhead Plant operations on the existing residential located within the Port Adelaide, South Australia following the noise reduction abatement program on 4B Stack, Limestone Reclaimer, Cement Mill 1 Dust Collector fan and Cement Mill 1 compressor has been completed.

The predicted noise levels due to the ABC Birkenhead Plant operations achieve the night time noise criteria for most of the noise sensitive receivers under neutral meteorological conditions with the exception of receivers R2, R5, R15 and R16, which are predicted to exceed by ~3/4dB. The predicted noise levels at the receivers associated with the worst case weather condition are generally achieved the noise criteria at most of the receivers apart from six receivers (R2, R5, R10, R12, R15 and R16), which the predicted noise levels are raised above the noise criteria by 3/4dB.

A noise comparison between the pre and post noise abatement program was made to compare the noise reduction achieved due to the recent modification work on the 4B stack, limestone reclaimer chain, cement mill 1 dust collector fan and cement mill 1 compressor. Predicted noise levels for worst case meteorological condition were considered only as it representative of the worst case noise propagation. The results show that the noise reduction abatement program achieved the noise reduction at most of the sensitive receivers with the exception of six receivers (R3, R8, R9, R10, R11 and R14). No noise reduction was noted at these six receivers for the reason that the receivers are located further away from the recent modification noise sources and predicted noise levels at these receivers are most likely dominated by other noise sources in ABC plants.

The remaining noise sensitive receivers are predicted to achieve a noise reduction by up to 4dBA. For instance, noise receiver at R16 achieves the most noise reduction from the noise abatement program (reduction of 4dB) and follows by noise receivers at R6, R12 and R18, which gain a reduction of 3dB and noise receivers at R2, R5 and R17 gain a reduction of 2dB. Other noise receivers (R4, R13 and R15) are also benefited from the noise abatement program, which gain a reduction of 1dB.

Overall, the noise reduction abatement program achieved a noise reduction at most of the noise receivers. However, the noise levels are predicted to raise above the noise criteria by 3dB or less during the worst case meteorological condition at R2, R5, R10, R15 and R16. It should be noted that a 3dB change in noise level is just noticeable or perceptible to average human ear.

Vipac recommends to continue in conducting environmental noise surveys at the noise sensitive receivers to get a trend of noise contribution from ABC Birkenhead Plant.

Appendix A GLOSSARY OF ACOUSTIC TERMINOLOGY

dB(A) A unit of measurement, decibels(A), of sound pressure level which has its frequency characteristics modified by a filter ("A-weighted") so as to more closely approximate the frequency response of the human ear.

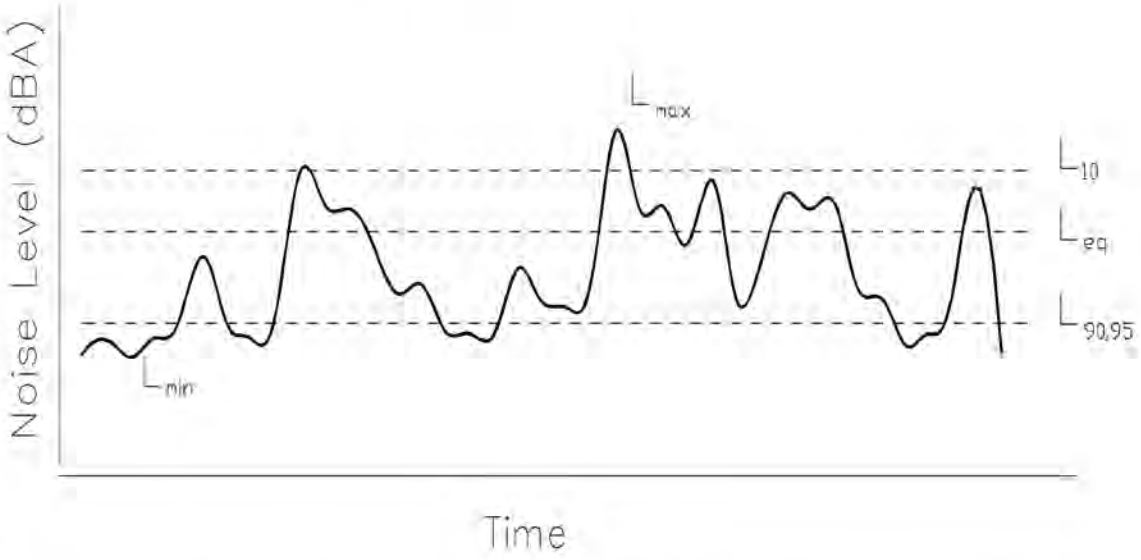
L_1 The noise level which is equalled or exceeded for 1% of the measurement period. L_1 is an indicator of the impulse noise level, and is used in Australia as the descriptor for intrusive noise (usually in dBA).

L_{10} The noise level which is equalled or exceeded for 10% of the measurement period. L_{10} is an indicator of the mean maximum noise level, and is used in Australia as the descriptor for intrusive noise (usually in dBA).

L_{90}, L_{95} The noise level which is equalled or exceeded for 90% of the measurement period. L_{90} or L_{95} is an indicator of the mean minimum noise level, and is used in Australia as the descriptor for background or ambient noise (usually in dBA).

L_{eq} The equivalent continuous noise level for the measurement period. L_{eq} is an indicator of the average noise level (usually in dBA).

L_{max} The maximum noise level for the measurement period (usually in dBA).



Note: *The subjective reaction or response to changes in noise levels can be summarised as follows*:

A 3 dB(A) increase in sound pressure level is required for the average human ear to notice a change; a 5 dB(A) increase is quite noticeable and a 10 dB(A) increase is typically perceived as a doubling in loudness

Appendix B SOUND PRESSURE LEVELS OF EQUIPMENT

Table 8-1:Pre-noise Abatement

Description	Distance (m)	LAeq	1/3 Octave Frequency Band																														
			16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.25k	1.6k	2k	2.5k	3.15k	4k	5k	6.3k	8k	10k	12.5k	16k	20k
4B Stack	15	79[2]	75	80	79	82	77	78	73	73	75	77	77	78	78	76	73	74	72	70	69	69	68	67	64	60	57	54	51	51	48	43	37	33
26 CM 1	7	90[1]	81	81	86	84	75	76	82	86	80	85	81	82	91	86	85	85	82	79	76	76	75	73	71	68	65	61	57	52	46	40	33	27
cement 1 compressor room 1	1	98	90	90	89	85	82	83	82	81	88	85	86	89	90	92	93	93	91	90	88	86	85	82	82	82	80	81	83	81	76	76	76	75
Lime Stone Reclaimer Shed - within building	-	91	79	78	79	83	81	87	86	85	84	84	83	80	79	78	86	81	78	77	77	79	80	81	84	74	76	79	77	71	69	68	67	56

Note: 1. Measured noise levels may be influenced by the noise from cement 1 compressor room.

2. The measurement was taken at ground floor adjacent to staircase near the plenum box.

Table 8-2: Post-noise Abatement

Description	Distance (m)	LAeq	1/3 Octave Frequency Band																														
			16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.25k	1.6k	2k	2.5k	3.15k	4k	5k	6.3k	8k	10k	12.5k	16k	20k
4B Stack	15	72[1]	81	81	83	85	81	76	67	67	69	71	70	68	68	67	68	65	64	64	63	60	59	56	54	53	51	50	48	46	42	37	33	28
26 CM 1	7	87	93	82	87	82	77	81	84	86	83	83	81	81	87	83	83	83	80	78	74	73	73	70	68	65	62	58	55	50	45	40	35	30
cement 1 compressor room 1	1	86	80	75	80	77	76	77	83	78	78	78	80	80	81	78	77	78	78	76	73	71	73	69	68	70	70	72	77	73	66	64	62	55
Lime Stone Reclaimer Shed - within building	-	81	77	82	80	79	79	83	79	78	80	79	77	76	75	74	81	73	72	70	68	66	69	65	59	57	53	53	52	45	45	41	36	29

Note: 1. Measurement was taken at top floor level (near 4A Elevator Duct Collector).

Presented in Table 8-1 and Table 8-2 are the measured noise levels of equipment before and after noise abatement.

Appendix C NOISE CONTOUR MAPS

ABC Birkenhead Plant Operations

Neutral Weather Condition

1.5 m Above Ground Level

ABC Birkenhead Plant Operations

Worst Case Weather Condition

1.5 m Above Ground Level

Noise Levels (dBA)

- 35dB(A)
- 38dB(A)
- 41dB(A)
- 44dB(A)
- 47dB(A)
- 50dB(A)
- 53dB(A)
- 56dB(A)
- 59dB(A)
- 62dB(A)
- 65dB(A)

N